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# How Integrating Digital Formative Assessment Impacts The Learning Of Sixth-Grade Science Students

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# HOW INTEGRATING DIGITAL FORMATIVE ASSESSMENT IMPACTS THE LEARNING OF SIXTH-GRADE SCIENCE STUDENTS

by

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TABLE OF CONTENTS

# CHAPTER ONE

## Introduction

### Overview

In 2013, 83.8 percent of U.S. households reported computer ownership according to the United States Census Bureau. In that same year, 74.4 percent of all households reported internet use. As a sixth-grade science teacher, these numbers meant that most of my students were getting their information, reading, and gaming digitally. Over the past three years, students were starting to ask if they could bring their digital devices to read with in class. Students wanted to use their cell phones to get more information on a topic we discussed in class. Just this past year our school district started a Bring Your Own Device (BYOD) initiative in sixth-grade. One hundred percent of the sixth-graders had a device of their own or could rent one from the school. These devices could be used to check for learning on a daily basis and communicate back to the student if they were on target.

Learning is the acquisition of knowledge or skills through experience, study, or by being taught. In a classroom with learning happening one would see independent students that move about the classroom engaged in problem-solving, students that are creatively solving challenges that are connected to their real-world, and students that are showing what they know in various ways. These students are engaged and motivated by being independent, creative, real world problem-solvers. Teachers monitor achievement regularly using a variety of summative and formative assessments for both individual

students and the class as a whole. It is an increase in achievement that constitutes learning.

Formative assessment, the process of gathering student data about their learning and communicating that feedback to students, occurred almost daily in my classroom. For example, I frequently used a formative assessment method called bell ringer questions. I posted a question or prompt on the board for students to answer; based on their responses, I gauged gaps in their learning and adjusted the class hour activities as necessary. Additionally, I posted learning targets in my classroom. In the last five minutes of class, students physically wrote down exit-slip answers related to the learning goals on real post- it notes and stuck them on the bulletin board called our classroom Twitter feed. I checked the exit slips for accuracy and followed up the next day with students who needed extra help. I knew they needed extra help if they asked questions or if their answers were not meeting the learning target.

Seeing my students on devices had me asking how I could combine technology and formative assessments. Creating a culture and space in which I used technology to communicate with my students about where they were at in their learning had the biggest impact on student achievement in my classroom in the following ways. I have found that students are more motivated and interested in the task at hand when I communicated with them regarding their learning. Formative assessment detracted from students' tendency to just want an A and refocused on the value of education. Technology improved the speed at which I could analyze the data and communicate the results back to the students. I

started to wonder if students that took part in digital formative assessments would display higher comprehension or motivation levels. All of that thinking led me to my question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?*

This chapter details my professional and personal experiences regarding technology in the classroom, formative assessment, and student engagement. The study showed that students comprehension in a class that uses more technology was the same as one that used traditional methods. However, student engagement and motivation increased when students used technology. I hoped that by showing these results to the school they may be more likely to spend money on more technology devices and training for teaching staff, and that teachers may be more liable to go to more technology training and implement more technology integrated lessons into a curriculum. Students have been more engaged and met learning targets.

**Digital Formative Assessment is Transformational**

Shianne was a smiley, happy go lucky eleven-year-old in my sixth-grade science class. However, in her words, she did not like science. It was hard, and Shianne believed she would never understand it. As she spoke, she lowered her head, and her shoulders slumped. We were going to have a quiz next week, and she was anticipating failure. Four days before the quiz we played Kahoot! as a class to review for the upcoming exam.

Kahoot! is a fun learning game, made from a series of multiple choice questions. Videos, images, and diagrams can be added to the questions to amplify engagement.

Students answered on their own devices, while games were displayed on the smartboard to unite the lesson and encouraged players to look up.

After we played Kahoot! to review for the quiz Shianne's face was lit up. She was beaming. She told me, "I loved that game, and I'm going to remember way more for the quiz!" Over the next couple of days, she played the game on her own to study. After the quiz she whispered to me, I remembered all the answers from the Kahoot! game. For the first time, Shianne got a B+ on an exam in science.

**Rationale**

The purpose of this action research project was to explore if integrating more technology into formative assessments had an impact on sixth-grader's comprehension on classroom assessments. It seemed most students were not engaged and motivated with paper, pencil, and book assignments. In my time teaching I had observed this in students who did not raise their hand to participate, they yawned, stared blankly, and they lost track of the conversation from zoning out. Therefore, they were not living up to their full potential to learn new concepts. Some students had become apathetic and bored. Tapscott (1998), for example, described education in developed countries as already in crisis with more challenges to come: "There is growing appreciation that the old approach is ill-suited to the intellectual, social, motivational, and emotional needs of the new generation" (p. 131).

There is a strong correlation between interest, engagement, motivation, persistent, self-identity and the ability to understand science and engineering (Ateh & Charpentier,

2014). This project involved teaching and learning. It meant taking out some of the paper, pencil, book assignments and replacing them with interactive, digital versions. Students would be learning the same material that was required previously but in a different format.

I felt passionate about technology. I knew that technology helped me engage in class. I had seen how Web 2.0 tools, collaborative online tools, and resources, could engage the most unmotivated student. Blogs could provide a platform for interaction for those who were afraid to speak up in class. Technology could make group projects more collaborative.

I helped present this information to the school board in my district in hopes of getting the bring your own device (BYOD) program approved. After school board consideration the program was approved. I worked closely with the district technology innovation specialist to implement many new internet-based programs and apps in my classroom. I enjoyed finding new ways to incorporate technology in my classroom and helping other teachers do the same. My colleagues knew that I tried new technology often and would often come to me with questions and new ideas. This collaboration and use of new technology was to create higher engagement in our students and we saw higher engagement. Did this higher engagement relate to greater comprehension, though?

Student understanding was something I wanted to improve. Not every activity was going to engage every student, but by diversifying classroom activities, I hoped to engage more students over time and therefore increase comprehension.

I hoped to learn that, through the use of technology integrated lessons, student engagement would increase, which would, in turn, mean students understand science concepts better. We can measure comprehension by giving pretests and posttests and learn about how students feel about their understanding of the learning targets through surveys.

**Context**

Based on my experience teaching science for seven years and my reading of the subject, I have been influenced by the theory of active learning. Bonwell and Eison (1991) suggested that students must do more than just listen to learn; they must read, write, discuss, or be engaged in solving problems. Most important, to be actively involved, students must commit to such higher-order thinking tasks as analysis, synthesis, and evaluation. Within this context, it is proposed that strategies were promoting active learning be defined as instructional activities involving students in doing things and thinking about what they are doing (Bonwell & Eison, 1991).

I hold the educational value that students should be able to transfer the skills they learn in science class to other aspects of their lives. I try to make my curriculum relevant to their lives. I believe that a technology integrated science class fits into the larger context of schooling and society by providing children with lifelong learning skills that can be transferred to all aspects of their life. My goal was to engage students better and therefore increase comprehension. To do that I needed to understand how digital formative assessments best integrated into a sixth-grade science classroom.

Students were not entirely engaged in class. Some students would do an activity or assignment just because a teacher was asking them to, not because it interested them. They were the altruists. Other students would not try the activity or task because they were bored and disengaged. I assumed they were bored, because they did not raise their hand to participate, they yawned, stared blankly, and they lost track of the conversation from zoning out. Some of these students were high academically but would not do the work, because they knew the content, and it was a boring activity. Other students who were average to low academically were disengaged because the activity did not draw them in. I used about one technology integrated lesson per unit. When I did, I noticed those typically bored students were more engaged.

A relationship exists between a science curriculum that integrates technology and student engagement in classroom activities. There is a strong correlation between interest, engagement, motivation, persistent, self-identity and the ability to understand science and engineering (Ateh & Charpentier, 2014). Students are struggling with engagement from paper, pencil, book activities, since it is so different from what they do in their lives. Eighty-eight percent of teens have cell phones, according to a 2015 survey by the Pew Research Center. Seventy-one percent of teens or eighty-three percent of teen boys play video games according to a 2015 Pew Research Center survey. Students are now drawn to the electronic devices they are so used to using at home. They were excited to do a lesson simply because we were on digital devices.

I was being encouraged by the school district I work in to implement more technology in my classroom to support a Bring Your Own Device (BYOD) initiative. The 2016-2017 school year was the first year of BYOD in my middle school. We were required to use our devices once per week in each class. I used devices daily in my class because of the positive impacts I saw. I also knew that devices could become a distraction. That is why I wanted to do this study to see if comprehension did increase with the use of technology.

**Summary**

Technology is here to stay and increasingly being used in twenty-first-century classrooms. My experiences with technology and formative assessment in the classroom have laid the foundation for my action research project. I was interested in moving beyond traditional formative assessment techniques and combined technology with formative assessment. How does the increased use of technology in classrooms impact student learning? It was not enough to merely substitute a keyboard for a pencil; technology-based lessons should be transformative. They should change the way students receive feedback about their learning and their awareness of where they are on the learning continuum. The intent was that digital formative assessments would help student engagement, which would, in turn, mean students understand science concepts better. These beliefs were the basis for my research question: *How integrating digital formative assessment impacts the learning of sixth-grade science students?*

Chapter two will be a literature review. The purpose of the literature review is to inform, present analysis, synthesize and elaborate on what experts say, reflect on what the experts say, and connect with other researchers and research communities. The literature review tells the broad conceptual issues related to formative assessment and student engagement and motivation. Digital formative assessments are transformational, because they engage students and give them real-time feedback. The literature review honors and presents analysis, synthesis, elaboration and reflection on the work of theorists and practitioners who have researched and published or implemented aspects of technology, engagement, and comprehension. It will analyze and synthesize information and sources.

Chapter three will be the methods of the investigation and why the approach was appropriate for the study are given. Chapter four will be the results. The results chapter documents how the study proceeded and what was found. Chapter five will be my reflections and the conclusions of the study. The final project will be shared with the school board, principals, teachers, and parents.

# CHAPTER TWO

## Literature Review

### Overview

My middle school students are assessed formatively in a few significant ways in my classroom every day, think-pair-share, exit slips, pre and post assessments, or with interviews. Some of these can be completed traditionally with paper and a pencil or digitally. Traditionally teachers may give their students an exit slip to fill in with a question they had that day or by writing down something they learned that day. Digitally, teachers may informally quiz their students using a game like Kahoot!, using a digital form of an exit slip on Nearpod, or asking questions online using questions in Google Classroom.

In the education setting, teachers see students on a daily basis and observe changes that occur in comprehension and engagement over a school year's time. In some cases, the changes are positive while other times they can be negative. The question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?* will be fully explored throughout this paper. Learning is the acquisition of knowledge or skills through experience, study, or by being taught. Learning is measured by assessment. Assessment can be formative, summative, direct, and indirect.

In this chapter, I present an overview of the research on *formative assessment* and *how digital mediums are becoming more prevalent in the classroom today*. I will also research *student engagement and ways to get students motivated* to learn. Finally, I

discuss comprehension and *how electronic devices are utilized in both of these areas*. These areas are essential to building the background for my inquiry into understanding and engagement with digital formative assessments and whether students display differences in comprehension when assessed on an electronic device versus other traditional formative assessments.

**Assessment and Learning**

Assessment is a broad term. It includes all actions that teachers and students engage in to get information that can then be used to evaluate and alter teaching and learning (Black & Wiliam, 1998). Formative assessments are for learning (Bennett, 2011; Spector, 2015). Formative assessment emphasizes forming judgments about students' progress that then affects the following flow of instruction; summative assessments are viewed as focusing on making judgments about how well individuals did at the end of an instructional course, which could be considered assessments of learning (Ecclestone, 2010). (Stiggins & DuFour, 2009)

**Formative Assessment.** When formative assessments are in the form of timely and informative feedback then they are aimed at helping learners improve (Spector, 2015). In a time when great importance is placed on summative assessment, Spector et al. (2016) suggested that formative assessment should have more emphasis put on it. According to Sadler (1989), formative assessments involve making judgments about the quality of students' responses and using those observations immediately to guide and improve students' understandings and skills. When done well formative assessment is

one of the most powerful tools a teacher has in helping student achievement (Stiggins & DuFour, 2009). “Teachers and schools can use formative assessment to identify student understanding, clarify what comes next in their learning, trigger and become part of an effective system of intervention for struggling students, inform and improve the instructional practice of individual teachers or teams, help students track their own progress toward attainment of standards, motivate students by building confidence in themselves as learners, fuel continuous improvement processes across faculties, and, thus, drive a school's transformation” (Stiggins & DuFour, 2009, p. 640). Ecclestone (2010) argued that formative assessment or assessment for learning is considered an integral component of good teaching, student motivation, engagement and higher levels of achievement. Also, timely and informative feedback (formative assessment) is known to enhance and expedite learning (Bransford, Brown, & Cocking, 2000).

**Traditional formative assessment techniques.** Black and Wiliam (1998) encouraged teachers to use questioning and classroom discussion as an opportunity to increase their students' knowledge and improve understanding. The questions should be thoughtful and reflective.

Black and Wiliam (1998) gave many examples of formative assessment which are described below. Invite students to discuss their thinking about a question or topic in pairs or small groups, then ask a spokesperson to share the thinking with the larger group (called think-pair-share). Present many possible answers to a question, then ask students to vote on them. Ask all students to write down an answer, then read a chosen few out

loud. Teachers could also evaluate students' understanding in the following ways: Have students write their knowledge of vocabulary or concepts before and after instruction. Ask students to summarize the main ideas they have learned from a class content. Have students complete a few problems or questions at the end of instruction and check answers; these are generally called exit slips. Interview students individually or in groups about their reasoning as they work through class assignments. Assign brief, in-class writing assignments. Frequent short tests, like formative assessments, are better than infrequent long ones or summative assessments. “New learning should be tested within about a week of first exposure” (Black and Wiliam, 1998, p. 48). Being mindful of test items is just as important as giving the test in the first place. Thus these authors suggest working with other teachers and outside sources to collect good test items.

**Elements of effective formative assessment**. Heritage (2007) stated that there are four core elements of formative assessment: 1) identifying the "gap," 2) feedback, 3) student involvement, and 4) learning progressions. To efficiently perform formative assessments teachers need to have a clear understanding of each of these elements. It is essential in formative assessment to identify the gap between a student's current status in learning and some desired educational goal (Heritage, 2007). This difference varies from student to student. It is important the teacher find the *just right* gap. If a gap too large, the student feels like they will never accomplish it; if a gap too small, and the student feels like it is not worth the effort. In educational psychology, this is called the *just right* gap the zone of proximal development (ZPD) (Vygotsky, 1978). Scaffolding is the help

educators give to students in the ZPD to aid them in moving from what they know to what they can do next. Teachers who perform useful formative assessments identify what a student may score in his or her ZPD. Then, change teaching to close the gap between a student's current state of knowledge and the desired state of learning (Heritage, 2007).

Students seek and teachers should provide feedback in many ways through the use of formative assessment. Knowing current levels of student understanding allows the teacher to plan the next steps in learning. Students should also be aware of their current level of knowledge, so they know what next steps to take, too. Sadler (1989) strongly emphasized providing feedback to students through the use of the feedback loop. The feedback loop is an ongoing process between teachers and students. Teachers tell the students how they are performing in an accurate, precise, criterion-based way so that the student knows how well they are learning. Students should also know how their knowledge differs from the desired learning goal. Teachers work with students to understand how to move forward. The teacher can modify instruction, assess again, and so on. Formative assessment should allow learners to use feedback to enhance their learning (Heritage, 2007).

Normative feedback, which relies on teacher comparisons of students, should be avoided because it tends to motivate students for extrinsic reasons and can lower expectations for success (Cauley & McMillan, 2010). Consequently, formative assessment works best when the teacher avoids grading practices and comments that show students how their performance compares to other students and uses informative

comments instead. If the only feedback students receive is a final grade (e.g., for a unit of instruction, midterms, finals, or external tests), they cannot see how their efforts improve skills, which may lower expectations for success in the future. Furthermore, the evaluative comments and judgments of ability that are prevalent in comparisons can be debilitating for students (Elliott & Dweck, 1988). To promote mastery goals, feedback from formative assessments should reduce social comparisons and instead emphasize progress toward achieving learning targets (Maehr & Anderman, 1993). A teacher might say 'Try to think of it this way.' or 'You're almost there. Keep working at it.'

The active involvement of students in the evaluation process improves learning through formative assessment. Students can learn the skills of self and peer assessment with formative assessment. As Sadler (1989) suggested, they collaborate with their teachers in developing a shared understanding of their current learning level and what they need to do to move forward in their education. Thus, they must reflect on their learning, monitor what they know and determine when they require more information. They can develop self-regulation strategies and adapt their learning tactics to meet their learning needs. According to Heritage (2007), it is important for students to work alongside their teacher to determine the criteria for success in education.

**Link between Formative and Summative Assessment.** The distinction between formative assessment and summative assessment is made largely in purpose and timing:—formative, so that the positive achievements of a student may be recognised and discussed, and the appropriate next steps may be planned—summative, for the recording

of the overall performance of a student in a systematic way (Harlan & James, 1997). When a student gets a question wrong, this would be *error* in a summative evaluation, but in formative evaluation, it provides diagnostic information.

If formative assessment is to guide educators and students, it must be linked to a learning sequence. The learning progression should clearly express the subgoals that constitute progress toward the ultimate goal. Most state standards, by themselves, do not provide a clear progression for understanding students desired goals. Many state standards do not provide a clear picture of what learning is required (Heritage, 2007). Learning progressions should be developed toward standards. The important aspects of what is to be learned are provided by the learning progressions. They help to pinpoint where a student is on the continuum of expected student progress. Students also need to have short-term goals, which are obtained from the learning progression and described regarding success criteria. "The success criteria are the guide to education while the student is actively learning. The formative assessments take place within the success criteria provided framework", and also make possible the interpretation of evidence (Heritage, 2007, p. 142).

Summative assessment takes place usually at the end of an instructional unit when achievement has to be reported. It can relate to progression in learning against state standards. They require methods which are as reliable as possible without endangering validity. Summative assessments should involve some procedures to make sure quality

assured. They should be based on evidence from the full range of performance relevant to the assessment being used (Harlan & James, 1997).

Summative assessment measures progress towards the big ideas rather than with the learning in specific activities. The criteria to be consistently applied relate to these big ideas, and in using them, the teacher will judge the degree of which the students have shown progress towards reaching them. For example, being able to use big ideas in other ways from those in which they were learned. Thus the teacher will look at several activities to assess the extent to which there is data or evidence of understanding indicated by summative assessment (Harlan & James, 1997).

For a reliable evaluation, as required for summative purposes, there must be certain conditions on the use of this formative information. First, it is reviewed strictly against the criteria of what students are expected to achieve certain standards. The principles are applied holistically, using judgments as to the best fit. Lastly, there is some way of ensuring that the views of one teacher are comparable with those of other teachers (Harlan & James, 1997). Formative and summative assessment do relate to each other in that they share a set of common criteria which are agreed on expectations regarding desired outcomes, but beyond this, they are inherently different phenomena with different premises and different methods. Some of the same evidence may be used for various purposes, but it will be utilized in a variety of ways (Harlan & James, 1997).

In my study I will use formative assessment to discuss the positive achievements of students, and use the assessments to plan the appropriate next steps in learning. The

diagnostic check will provide information to me and the student about where the student is on the learning continuum before and during preparation for a summative assessment.

**Why Formative Assessment Can be Engaging and Motivating.** Formative assessment is currently a "hot topic" among teachers and administrators. It is also recognized as one of the most powerful ways to increase student motivation and achievement (Cauley & McMillan, 2010). Formative assessment is consistent with recent constructivist theories of learning and motivation (Cauley & McMillan, 2010). "A high-level formative assessment should be intrinsically motivating" (Cauley & McMillan, 2010, p.1).

"Formative assessment is a planned process to the extent that the teacher consciously and continuously receives data of student performance and then uses this information productively, resulting in increased student motivation and engagement" (Cauley & McMillan, 2010, p.1). Task-specific comments influence students' interest and commitment more positively than either grades or praise (Butler & Nisan, 1986). An example of this sort of comment might be, "You have included quite a few examples in your paper. Can you think of any more notable examples?" Both high- and low-achieving students who receive private feedback demonstrate more engagement and a lower focus on how their abilities and successes compare to others' accomplishments (Brookhart, 2008 & Butler, 1987).

Another important aspect of the relationship between feedback and learning, according to Heritage (2007), is that feedback has a powerful effect on students'

motivation and their sense of self-efficacy or how they feel about their various abilities. Both of these are major influences on learning. Formative assessment's emphasis on instructional modifications and student improvement supports student motivation and enables them to maintain high engagement and achievement. Using formative assessments is indeed a key to student motivation and achievement (Cauley & McMillan, 2010).

**Student Engagement and Motivation**

Students need to be actively engaged to achieve (Parsons, Richey Nuland, & Ward Parsons, 2014). On-task does not necessarily mean engaged (Parsons et al., 2014). Some students look busy when they are not participating in academic activities. Also, in some classrooms, students are intimidated into being on-task but do not have an eager desire to learn. Teachers can raise engagement by understanding that it is important, knowing the tasks that encourage it, and having tools for assessing it (Parsons et al., 2014).

Student engagement is malleable and dynamic. It is influenced by context and situations (Parsons et al., 2014). It can change depending on the activity, the time of day, the group, or the tools used in the activity. There is a strong correlation between interest, engagement, motivation, and the ability to understand science and engineering (Ateh & Charpentier, 2014). Student engagement has three parts: affective, behavioral, and cognitive (Parsons et al., 2014).

**Parts of engagement.** *Affective engagement* includes a sense of belonging in the classroom and interest, curiosity, or enthusiasm around topics or tasks (Parsons et al., 2014 & Archambault et al., 2009). It mainly addresses liking school, belongingness, interests, and general enthusiasm for learning. Embedding activities enhance student interest (Ateh & Charpentier, 2014).

*Behavioral engagement* includes time-on-task and active participation (Parsons et al., 2014 & Archambault et al., 2009). It is rooted in classroom community, not fear or intimidation (Parsons et al., 2014). For example, attendance and politeness, student involvement in class work and discussions and extracurricular activities.

*Cognitive engagement* includes perseverance and using metacognitive and self-regulated strategies (Parsons et al., 2014). This dimension concerns student psychological involvement in learning (e.g., perceptions of competency, willingness to engage in effortful learning, and task-oriented goals) and use of self-regulation strategies (e.g., memorization, task planning, and supervision) (Archambault et al., 2009). Example: a student who asks to stay after school to think more about a topic and wants to share the findings with the class.

Engagement shows itself in various forms. A teacher cannot look to one behavior to prove a student is engaged. Engagement can be observed when a student hangs around after class to further discuss a topic, actively participates in class discussions, or shows an enthusiasm for learning.

**Evaluating student engagement.** There is a spectrum of student engagement ranging from engagement to disaffection (Parsons et al., 2014). Highly engaged students are actively participating in class discussions, are enthusiastic, have a positive attitude toward schoolwork. Disengaged students are bored and indifferent about academic tasks (Parsons et al., 2014). Teacher researchers have used self-reporting, teacher reporting, and observations to assess student engagement (Drace, 2013; Niemi & Multisilta, 2015; Parsons et al., 2014).

In summary, students need to by actively engaged to attain learning goals. Teachers can foster intrinsic motivation in students through positive relationships, pedagogical approaches, and creating a classroom environment that encourages a mastery goal orientation. Engaged students are enthusiastic and have positive attitudes toward school.

**Intrinsic versus Extrinsic Motivation.** A performance goal emphasizes comparison of students' abilities (Cauley & McMillan, 2010). Students who pursue performance goals demonstrate debilitating behaviors and are more likely to procrastinate, use superficial approaches, and, with some groups, present cheating behaviors (Meece, Anderman, & Anderman, 2006). Performance-goal-oriented students typically show a keen interest with how their skills are assessed by others and the attention (or lack thereof) that may come of the attention. Both high and low-achieving students who received grades and praise on their written work showed an increase in performance orientation contributing to extrinsic motivation (Butler, 1987).

Intrinsic motivation refers to behavior that is driven by intrinsic rewards. In other words, the motivation to join in a behavior occurs from within the individual because it is intrinsically rewarding. Extrinsic motivation refers to behavior that is induced by external rewards such as money, fame, grades, and praise. This type of motivation starts from outside the individual.

A mastery goal orientation emphasizes learning, understanding, improving, mastering new skills, and taking on challenges (Cauley & McMillan, 2010). Students who pursue mastery goals share many positive achievement characteristics. For example, these students use deeper cognitive strategies than other students and relate new learning to prior knowledge (Anderman, Austin, & Johnson, 2002). These students tend to be more determined when facing challenging tasks (Meece, Anderman, & Anderman, 2006). These characteristics are also indications of intrinsically motivated students.

An emphasis on task goals, which focus on learning and meeting standards, as opposed to goals that emphasize how they compare to other students increases students' intrinsic motivation and when coupled with other formative assessment methods, also further supports the adoption of mastery goals.

**Technology and Learning**

The question is no longer should we use technology in the classroom, but how do we use technology in the classroom? Students of today are digital natives. These students have been absorbing technology their whole lives. Teachers now have technology

standards to teach and it is important to recognize when and how to implement technology in the classroom.

Historically speaking, The Goals 2000: Educate America Act (1994) authorized state planning for improving student achievement through integration of technology into the curriculum. Standards for connecting curriculum and technology are being designed and implemented (Goddard, 2002). Currently, The International Society for Technology in Education (ISTE) sets those standards. There are standards for students as well as teachers. Standards provide a common language for skills, goals, and expected outcomes (Barr and Sykora, 2015).

An important question educators must consider is how to measure personal satisfaction with computers, rather than simply assessing the effectiveness of the computer as a teaching tool, students need to find motivation, interest, and a reason for technology to advance their ability to learn. “The human-to-computer interaction is a function of psychology as well as the specific technologies employed. It is a question of presentation versus learning style, with technology as the interface between the user and active learning” (Goddard, 2002, p. 23). With that in mind, the answer to how educators should best use technology may be found within a framework for technology-based teaching and learning that focuses on engagement (Goddard, 2002).

When using technology it should make a lesson better. Keeler (2016b) encouraged teachers to think about the four C’s when planning a technology enhanced lesson. Does the use of technology allow for more collaboration, increase critical thinking

opportunities, can students clearly communicate their ideas in a unique way, and can students demonstrate creative thinking? “Technology does not create engagement, your lesson design does” (Keeler, 2016b). Technology cannot just be a replacement for paper.

Another reason for technology integration is teaching 21st-century skills (Edutopia Technology Blog, November 5, 2007). According to this blog, these skills include, “personal and social responsibility planning, critical thinking, reasoning, and creativity, strong communication skills, both for interpersonal and presentation needs, cross-cultural understanding, visualizing and decision making, knowing how and when to use technology, and choosing the most appropriate tool for the task”. This resource said, today’s students are tech-savvy, more tech dependent, and can be impatient multitaskers. It is important for educators to teach 21st-century skills in the classroom.

**Limitations of Technology.** Technology cannot replace human-to-human interaction. “With face to face instruction I am able to immediately use the information from what students are doing in class to make adjustments immediately” (Keeler, 2013). A teacher can use email or online comments to give student feedback which is useful, but the teacher cannot observe how the student responds when they read those comments (Keeler, 2013).

Technology can become a distraction in the classroom if students are not engaged in the lesson (Ronan, 2017). This can be the number one worry of teachers adding technology to their lessons. Another worry is that not all students have access to devices or internet outside of the school day. The library is always an option, but not realistic for

some families to use. Privacy is another concern for many teachers implementing technology in their classrooms. Apps and platforms have privacy measures set up, but with recent hacks in the news many schools are left wondering how safe their student data is (Ronan, 2017). Jordan (2012) pointed out concerns that "people who read print text comprehend more, remember more, and learn more than those who read digital text; print textbooks cannot crash, freeze, or get hacked; tablets are more susceptible to theft than print textbooks" (Among the Cons section).

It is appropriate to have a blend of technology enhanced lessons in the modern classroom. Teachers should not be replaced by technology. Technology should be used when it can strengthen a lesson.

**Justifying Technology: Engagement.** Technology can be used to strengthen student engagement through motivation and providing scenarios where students make their unique contributions, such as through a blog or video (Niemi & Multisilta, 2015). Having students add their individual contributions is a student-centered approach that connects the classroom with the community (Ateh & Charpentier, 2014; Niemi & Multisilta, 2015).

Technology allows students to express themselves in various ways, which is engaging, and enriched by technology (Keeler, 2016b). "No one learns in the same way or at the same pace, but technology can level-set the classroom" (Capella Education Blog, May 23, 2017). Technology can provide accommodations for struggling or disabled students and enrichment for others.

"Since students are already interested and engaged in technology, teachers can harness that attention for educational purposes" (Capella Education Blog, May 23, 2017). Technology can engage and create active learners. Students can be actively investigating a topic versus only passively listening to a lecture. According to this blog, there is more collaboration in technology enhanced lessons. Students with higher technology skills often help their partners with lower skills. Teaching with technology in K-12 education helps students prepare for the use of technology in life and work and reduces the fear of new technology in the future.

A more recent trend in pedagogy is using game design elements to increase student engagement and motivation (Drace, 2013). Gamification is the application of game design (accruing points or badges, reaching levels, or other rewards) in a non-game context to motivate participation (Drace, 2013).

Student responses to the use of technology are overwhelmingly positive. Students feel engaged and interested in class topics. They enjoyed the interactivity and collaboration (Drace, 2013; Niemi & Multisilta, 2015).

For engagement to occur, the teacher must create an environment that encourages a student to teacher contact, cooperation among students, and active learning (Goddard, 2002). Teachers must provide prompt feedback, emphasize time on task, communicate high expectations, and respect diverse talents and ways of learning. Keeler (2016a) stated, "Good formative assessment allows you to be quickly responsive to student needs. Google Forms gives you the data from students instantly after they press submit."

Students are also more engaged by being included in classroom activities and their learning. “Teaching can be elevated with technology to include student activities that involve students in research projects, encourage small-group collaboration and discussions, require in-class presentations and debates, employ simulations, and create opportunities for individual learning projects” (Goddard, 2002, p. 21).

Diemer, Fernandez, & Streepey (2012) did a multidisciplinary assessment of college student opinions of engagement and learning using iPads. Student responses following single and multiple classroom exercises using iPads were measured by a survey asking them to rank their learning and engagement using a 5-point Likert scale. Responses to the questions were grouped into thematic categories of perceived knowledge and perceived engagement. Students who described a high level of engagement while using iPads reported a high standard of learning, as well. No differences due to age, gender, or language were found. Students who identified themselves as content with forms of e-learning described significantly greater levels of perception of learning and engagement. Those who described being comfortable were more likely to use iPads for learning and professional development in the future. Furthermore, some students who initially described themselves as somewhat uncomfortable with e-learning technology also reported interest in continuing to use iPads. (Diemer, Fernandez, & Streepey, 2012)

**Digital Natives Debate.** A new generation of students is joining the education system, and that has triggered recent attention among educators. Termed *digital natives*

or the *Net generation*, these students are said to have been absorbed in technology all their lives, instilling them with advanced technical skills and learning preferences for which traditional education is unprepared. According to Bennett, Maton, and Kervin (2008), grand claims were being made about the nature of this generational change and the pressing need for educational reform as the answer. A sense of coming crisis permeates this debate. However, the actual status is far from clear (Bennett, Maton, & Kervin, 2008).

Bennett, Maton, and Kervin (2008) argued that rather than being empirically and theoretically acquainted, the debate can be compared to an academic form of a moral panic. They propose that a more measured and disinterested approach is required to investigate digital natives and their implications for education.

**Assertions about digital natives.** The generation born approximately between 1980 and 1994 has been characterized as the digital natives (Prensky, 2001) or the Net generation (Tapscott, 1998) because of their experience with and dependence on information and communication technology (ICT). They are represented as living lives immersed in technology, surrounded by and using computers, videogames, digital music players, cell phones, and all the other toys and tools of the digital age (Bennett, Maton, & Kervin, 2008).

Immersion in this technology-rich society is said to affect the abilities and concerns of digital natives in ways notable for education. It is said, for example, that digital natives learn differently compared to earlier generations of students. They are

believed to be active, experiential learners, proficient in multitasking, and reliant on communications technologies for obtaining information and for interacting with others (Bennett, Maton, & Kervin, 2008; Prensky, 2001). Some education analysts claim these points raise significant questions about whether education is currently equipped to satisfy the needs of this new group of students. Tapscott (1998), for example, reported education in developed countries as already in crisis with more difficulties to come: "There is growing appreciation that the old approach is ill-suited to the intellectual, social, motivational, and emotional needs of the new generation" (p. 131). Prensky (2001) added that: "Our students have changed radically. Today's students are no longer the people our educational system was designed to teach" (p. 1).

For those born before 1980, Prensky (2001) has coined the term digital immigrants. He claims that this section of the population, which includes many teachers, requires the technological fluency of the digital natives and sees the skills possessed by them almost entirely foreign. Prensky (2001) characterized this as “the biggest single problem facing education today” (p. 3). To address this proclaimed challenge, some analysts are fighting for comprehensive reforms in curriculum, pedagogy, assessment and professional development in education.

The discussion over digital natives is therefore based on two key parts: (1) that a distinguished generation of 'digital natives' exists; and (2) that education must radically change to meet the needs of these 'digital natives.' And, according to Bennett, Maton, and

Kervin (2008), are based on fundamental assumptions with weak empirical and theoretical foundations.

**Conclusions about digital natives.** The idea starting to arise from research on adolescents' link with technology is much more complicated than the digital native characterization suggests. While technology is rooted in their beings, teens' performance and abilities are not consistent. There is no indication of broad disaffection, or of a sharply different learning style the like of which has never been seen before. We may live in a highly technologized world, but it is conceivable that it has become so through evolution, rather than revolution (Bennett, Maton, & Kervin, 2008). Young people may do things differently, but there is no reason to consider them alien. Education may be under provocation to change, but it is not clear that it is being rejected.

More analysis needs to be done on digital natives and how they learn best. This is not to say that young people are not engaged and interested in technology and that technology might not support active learning. It is to ask for considered, and close examination that includes the views of young people and their teachers, and genuinely attempts to understand the situation. Students are bringing technology with them to class in the form of smartwatches, smartphones, and laptops. Therefore, investigating practical ways to implement technology in my classroom drives my research.

**Summary**

Assessment and learning, student motivation and engagement, and technology use for learning are closely related and overlap in many areas. In this digital age, it is

necessary and beneficial to integrate technology into the classroom. Doing so improves student motivation and engagement (Drace, 2013; Niemi & Multisilta, 2015), and also strengthens the digital skills students, and adults, will need to be successful in the future. Technology cannot be separated from today's classroom. Students are wearing smartwatches on their arms and have smart phones in their pockets. Even if a teacher wanted to avoid technology in the classroom, most students are bringing technology with them to class. Therefore, investigating practical ways to implement technology in my classroom, in regards to formative assessment, drives my research question. Formative assessment is an effective tool that can improve student learning and understanding by showing teacher and student where the student's learning is on the expected learning continuum. "Adolescent motivation is increased through a meaningful learning environment where the teacher creates a classroom that encourages student-to-teacher contact, cooperation among students, and active learning" (Goddard, 2002, p. 25). Therefore, all three areas interact with one another and contribute to the same end goal: improving student learning. My research question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?* investigates how to use both formative assessment and technology to increase student engagement and understanding. In chapter three, I describe the research methods used when I conducted my action research project.

# CHAPTER THREE

## Methods

### Overview

Technology is a powerful tool to utilize in the classroom. But, it is important that it be used effectively, or it can become a distraction. Digital formative assessments are transformative because they engage students and give them real-time feedback. Both high- and low-achieving students who receive private feedback demonstrate more engagement and a lower focus on how their abilities and successes compare to others' accomplishments (Brookhart, 2008 & Butler, 1987). Digital formative assessments allow teachers to give that individual feedback quicker and in real-time. When students are engaging, receiving timely feedback, and intrinsically motivated, they are learning.

For my research study, I investigated how student learning was impacted by a curriculum unit that engaged students in digital formative assessments. This chapter addresses the methodology used to answer the question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?* First, a description of the research paradigm is discussed. Use of a mixed method approach to research was decided. Second, the research methods are presented, as well as an overview of the instruments used. Next, this chapter focuses on the setting and the participants of the study as well as the human subject research review process. Finally, the data analysis is presented.

## Paradigm

I used a mixed methods research paradigm. One of the benefits of a mixed methods research paradigm is to compare different perspectives drawn from quantitative and qualitative data. One can explain quantitative results with a qualitative follow-up data collection and analysis. I gained a better understanding of the need for and impact of technology in the classroom through collecting both quantitative and qualitative data over time (Creswell, 2014). The purpose of mixed method research was to build on the cooperation and strength that existed between qualitative and quantitative research methods.

For my research study, I wanted to know what the quantitative data showed for sixth-graders' comprehension after using more technology in the classroom. But, I also wanted to know how the students think and feel about using more technology.

## Research Methods

Qualitative research is research that seeks understanding and findings from the perspectives of the participants in the study. Qualitative approaches to research might include conducting face-to-face interviews, making observations, and surveys (Mills, 2014, p. 6). By comparison, quantitative research is the collection and analysis of numerical data to describe, explain, or predict phenomena of interest (Creswell, 2014, p. 156).

**Quantitative Methods.** The quantitative research method I used was to see if students' summative assessment scores that participated in traditional formative

assessments differed from similar students, in the same setting, and studying the same unit that engaged them in traditional and digital formative assessments. The first group of students took the assessment in 2016 and the second group in 2017. The digital formative assessments used were Kahoot!, Nearpod, and asking questions on Google Classroom. Students were given the same summative assessment on the unit of study (see Appendix C).

**Qualitative Methods.** During the study, I administered a traditional formative assessment survey and a digital formative assessment survey to the 2017 participants by using Google Forms, which was administered to students online, and ensured students' anonymity (see Appendix B). The surveys gave students opportunities to voice their opinions and share their experiences concerning digital formative assessment. The survey used a Likert scale of six questions. The questions revolved around the formative assessment preferences (digital or paper/pencil) of the participants. There were also two questions that asked the participants to write out their reasons for why they like/dislike paper/pencil exit slips and why they like/dislike questions in Google Classroom, Kahoot!, and Nearpod. Mills (2014) states that by using this approach, it allows the researcher to collect significant amounts of data in a short amount of time.

## Setting

The participants of this study attend a rural middle school in the upper Midwest. The rural town is primarily Caucasian with a population of 14,000. But, the city is surrounded by farming communities. The middle school has an enrollment of 688

consisting of students in grades 6-8. The middle school population is 90 percent White, 7 percent Hispanic, 2 percent Black, and 2 percent Asian. Also, 26.2 percent of the student population qualifies for the free and reduced lunch program. Each student is in my science class for a 50 minute class period per day. For the 2017 group of students, each student had access to a Chromebook and wireless internet. The 2016 group of students did not.

**Participants**

The students in this study were in sixth-grade and were eleven and twelve years old. There were 97 students who participated in the study. All of the students spoke proficient English. Thirteen percent of the students who took part in the study received Special Education services. Also, 7 percent of students have been identified as at-risk by their attendance, grades, and in school behavior.

All of the study participants were familiar with electronic devices and used them on a daily basis. The sixth-grade was participating in the initiative bring your own device (BYOD) and encouraged the use of electronic devices for educational purposes during class. Students were invited to buy a Chromebook but could use any laptop device. If a student could not afford a device or forgot theirs for the day, they could check one out in the media center.

**Human Subject Research Review Process**

To protect the participants of this study, I followed the procedures of the Hamline School of Education Institutional Review Board. Following my capstone proposal

meeting, I submitted my proposal to the Hamline University Institutional Review Board. Once my application was approved, I moved forward with the research. I sent a letter of consent home with each participant explaining the procedures and purpose of the study (see Appendix A). The consent form had to be returned before a participant's data would be included in the data analysis. Also, student names were changed to protect their identities.

**Data Analysis**

The traditional formative assessment student survey was given at the beginning of the science unit and the digital formative assessment survey was given at the end of the science unit. Students had been engaging in both types of formative assessment throughout the school year. The surveys were spaced out in time to alleviate survey fatigue. The surveys were administered on Google Forms and the multiple choice results were automatically collected on a spreadsheet with graphs. I manually read each open ended answer and grouped answers according to likeness and categorized the groups.

The summative assessments were taken digitally using Quia. Quia scores the assessment automatically from a teacher generated answer key. Scores the students acquired on the summative assessments automatically were put into a spreadsheet on Quia. It was then determined how the overall average on the summative assessment was compared to the overall average of the summative assessment given to a similar population in 2016.

**Summary**

This chapter described the research paradigm. I also discussed the methods, setting, and participants for this research study. I have given an overview of how I collected the data and the general procedure I followed to analyze the data to help answer my research question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?* In Chapter 4 the research results and analysis will be presented to gain understanding into how comprehension and engagement levels can be affected when using digital formative assessments.

# CHAPTER FOUR

## Results

### Overview

The goal of the study was to evaluate the impact of digital versus traditional formative assessment as reflected in student summative assessment scores and student surveys. This chapter will overview student assessment data over the unit of study that was taught in the spring of 2016 and again to a similar student group in the the spring of 2017. The 2016 unit was exclusively taught using traditional formative assessment and the 2017 unit was taught using traditional and digital assessment. Qualitative student feedback regarding both digital and formative assessment was gathered and will be displayed. Lastly, I will analyze these data tools to determine how digital formative assessment increased student learning. The data collected contributes to answering the question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?*

### Procedure

I conducted my research over a period of two weeks, beginning on March 27, 2017 and concluding on April 6, 2017. To determine the effectiveness of digital formative assessment, I gathered qualitative and quantitative data over one unit of study that utilized traditional formative assessment and digital formative assessment. After the unit concluded, students were given a summative assessment of the unit's topic which was energy and waves (see Appendix C). The same summative assessment was given to a

similar student group in 2016, however that group of students only used traditional formative assessments during the unit. The same summative assessments were given to all class periods. Additionally, the summative assessments were given to each 2017 class period on the same date and to each 2016 class period on the same date, using the same delivery methods. Assessments were given digitally using Quia (see Appendix D) and students independently completed them. The qualitative method I used to gather student feedback were surveys given on Google Forms (see Appendix B) before and after the unit of study for the 2017 students only. These surveys gave students a chance to voice their opinions regarding traditional and digital formative assessment.

When using traditional formative assessment, students were given seven minutes at the end of the class period to independently fill in an exit slip. Each day, I would pass out post-it notes. I would project their exit slip question or task on the SMARTBoard and students would individually complete their exit slip. Near the conclusion of the class period, students stuck their exit slip to the bulletin board next to their preassigned class number, and we would discuss the answers to the exit clip question or task. Additionally, I gave students feedback regarding their exit slips and they picked them up at the beginning of the next class period, where we would also discuss the learning as a whole class.

When digital formative assessments were used the routine was different. Questions in Google Classroom, Kahoot!, and Nearpod (see Appendix D) incorporate formative assessment throughout the lessons. Questions in Google Classroom were

utilized at the beginning of each class to check for understanding from previous lessons and to front load new information. Students all have a Google login and are in the routine of logging in and answering the bell ringer question of the day as the first task they do every day after they walk in the room. Each student's answer was individually recorded and populated into the app on my end, but also stays on the student's end. If made available by the teacher, students can also see their peers' answers. Once I could see that students had submitted their responses on the bell ringer question of the day, we would share answers together as a whole class on the SMARTBoard. Later on, I would comment on students' bell ringer question of the day, which they could instantly see. The next class students would answer the question of the day and then view the feedback I gave them on questions in Google Classroom from the previous day, and a discussion of the learning, which drove the rest of the class period.

Kahoot! required students to log in using a unique code and nickname that brought them to a quiz game. Once they were logged in, students could interact with the digital quiz game. Students, "players", were asked questions in real-time creating a social, fun and game-like learning environment. During the quiz game we could all see how the class was doing as a whole. On questions where less than 70 percent of the class got the question correct we would stop and have a discussion. The results, including who answered what for each question, were downloaded afterwards. Later on, I would email students on their Kahoot! results, which they could instantly see. The next class period

opened with students viewing the feedback I gave them on Kahoot! via email, and a discussion of the learning, which drove the rest of the class period.

Nearpod required students to log in using a unique code and username that brought them to the interactive mobile presentation. Once they were logged in, students could interact with the mobile presentation. The content of the presentations was made up of real time slideshows with videos, reading, websites, student generated drawings, quizzes, and polls. As the teacher I controlled the presentation on students' devices. Students only advanced slides as I did from my own device. Each student's answer was individually recorded and populated into the app on my end, but also stays on the student's end. During the interactive presentation we could all see how the class was doing as a whole on poll questions. On questions where less than 70 percent of the class got the question correct we would stop and have a discussion. On essay style questions and drawings I could choose student examples to share instantly with student names removed. At the end the results, including who answered what for each question, were downloaded. Later on, I would email students on their Nearpod results, which they could instantly see. The next class period opened with students viewing the feedback I gave them on Nearpod via email, and a discussion of the learning occurred, which drove the rest of the class period.

**Quantitative Data Results**

Both student groups, one in 2016 and one in 2017, were given the same summative assessment in the same format. The unit of study was on energy and waves.

The summative assessment was a combination of multiple choice, true or false, matching, solving for kinetic energy, and short answer questions (see Appendix C). Below is a table illustrating the summative assessment scores from this unit:

Table 1.

| *Summative Assessment Results* | | |
|---|---|---|
| 2016- With traditional formative assessments only | 2017- With traditional and digital formative assessments | Difference |
| 88.14% | 87.69% | 0.45% |

The 2016 group and 2017 group of students scored 0.45% different on the summative assessment. There is essentially no difference in the assessment results from 2016 when students only used traditional formative assessments to 2017 when students used a combination of traditional and digital formative assessment results.

Before and after the unit, the 2017 students were also given a survey about their attitudes toward Chromebooks, the content of the class, whether they felt motivated to do their best in the class, and whether they preferred paper or digital formative assessment. The surveys were given anonymously on Google forms so students could feel more comfortable in answering honestly. Furthermore, there were two short answer questions on each survey. This allowed students to voice their opinions in a more precise and straightforward way.

Table 2.

| *Student Responses: I feel totally comfortable when it comes to using paper and pencil. (Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 38.1% | 49.5% | 10.3% | 2.1% |

Table 3.

| *Student Responses: I feel totally comfortable when it comes to using my Chromebook. (Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 62.9% | 36.1% | 0.0% | 1.0% |

Most students feel totally comfortable using their pencil and using their Chromebook (see Tables 2 and 3). However, more students feel comfortable using their Chromebook than their pencil. We used Chromebooks in class more than paper and pencil overall and that may have led to students feeling more comfortable with Chromebooks.

Table 4.

| *Student Responses: The paper/pencil exit slips, think/pair/shares, and thumbs up/down help me learn in science class this year. (Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 15.5% | 68.0% | 14.4% | 2.1% |

Table 5.

| *Student Responses: Questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod help me learn in science class this year.* *(Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 73.2% | 25.8% | 0.0% | 1.0% |

Most students thought the traditional and digital formative assessments helped them learn (see Tables 4 and 5). However, more students thought the digital formative assessments helped them learn. Additionally, 16.5% of students did not think the traditional formative assessments helped them learn.

Table 6.

| *Student Responses: I like using paper/pencil for exit slips, think/pair/shares, and thumbs up/down.* *(Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 15.5% | 54.6% | 22.7% | 7.2% |

Table 7.

| *Student Responses: I like using Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod.* *(Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 76.3% | 21.6% | 0.0% | 2.1% |

Most students like using traditional and digital formative assessments (see Tables 6 and 7). The feelings are much stronger for digital formative assessments. Also, 76.3% of students strongly agree that they like digital formative assessments versus only 15.5% of students strongly agree that they like traditional formative assessments. Additionally, 29.9% of students did not like traditional formative assessments at all.

Table 8.

| *Student Responses: The paper/pencil exit slips, think/pair/shares, and thumbs up/down made science class this year more interesting. (Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 12.4% | 53.6% | 32.0% | 2.1% |

Table 9.

| *Student Responses: Questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod on the Chromebook made science class this year more interesting. (Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 69.1% | 26.8% | 3.1% | 1.0% |

Most students think that both traditional and digital formative assessments made science class more interesting (see Tables 8 and 9). Again, students responded more strongly toward the digital formative assessments; 69.1% of students strongly agreed that digital formative assessments made science class more interesting. Whereas, only 12.4% of students strongly agreed that traditional formative assessments made science class more

interest. Additionally, 34.1% of students did not think traditional formative assessments made class more interesting.

Table 10.

| *Student Responses: I like using paper/pencil exit slips, think/pair/shares, and thumbs up/down better than using the Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod.* *(Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 11.3% | 6.2% | 32.0% | 50.5% |

Table 11.

| *Student Responses: I like using the Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod better than using the paper/pencil exit slips, think/pair/shares, and thumbs up/down.* *(Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 67.0% | 27.8% | 3.1% | 2.1% |

Most students like using Chromebooks better than paper/pencil (see Tables 10 and 11). The same question was asked two different ways and given on two different days. When phrased as in Table 10, 82.5% of students responded that they prefer Chromebooks. When phrased differently, as shown in Table 11, 94.8% responded that they prefer Chromebooks to paper/pencil. It could be that student only read and responded to the the first part of the question. This was the longest question on the survey.

Table 12.

| *Student Responses: Paper/pencil exit slips, think/pair/shares, and thumbs up/down motivate me to do my best in science class this year. (Traditional Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 13.4% | 51.5% | 32.0% | 3.1% |

Table 13.

| *Student Responses: Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod motivate me to do my best in science class this year. (Digital Formative Assessment)* | | | |
|---|---|---|---|
| Strongly Agree | Agree | Disagree | Strongly Disagree |
| 38.1% | 51.5% | 9.3% | 1.0% |

Most students responded that both traditional and digital formative assessments motivated them to do their best in science class (see Tables 12 and 13). However, 35.1% of students responded that traditional formative assessments did not motivate them to do their best in science class. More students strongly agreed that digital formative assessments motivated them to do their best in science class.

**Qualitative Data Results**

Below are the responses to the two short answer questions that were on each survey. These questions allowed students to voice their opinions in a more precise and straightforward way. For example, in the above multiple choice it was asked if students like Chromebooks for digital formative assessments. The surveys were administered on Google Forms. I manually read each open ended answer and grouped answers according

to likeness and categorized the groups. Below they are asked why they like or dislike Chromebooks or digital formative assessments.

Table 14.

| *Student Responses: What don't you like about paper/pencil exit slips, think/pair/shares, and thumbs up/down?* *(Traditional Formative Assessment)* | |
|---|---|
| I don't like traditional formative assessments because I like Chromebooks better and my hand hurts when I write. | 28.9% |
| I don't like the logistics of traditional formative assessments. Examples: messy handwriting, space to write, and time. | 14.4% |
| I don't like how my peers act toward traditional formative assessments. Examples: lack of effort, perceived dishonesty, disagreements over answers, and put-downs. | 13.4% |
| I don't like like sharing with the whole class during traditional formative assessments. | 13.4% |
| There is nothing I don't like about traditional formative assessments. | 12.4% |
| I don't know what to share during traditional formative assessments. | 5.2% |
| I don't like traditional formative assessments because they are not exciting, they are boring. | 4.1% |
| I don't like traditional formative assessments because they don't help me learn. | 3.1% |
| I don't like traditional formative assessment for other various reasons | 3.0% |
| I don't like the traditional formative assessments because I know a lot about the topic already. | 2.1% |

When asked, What don't you like about paper/pencil exit slips, think/pair/shares, and thumbs up/down, 14.4% of students didn't like the time it took them to write with paper and pencil, the space they had available for writing or the neatness of their

handwriting when doing traditional formative assessments (see Table 14). 22.7% of students didn't like wasting time when the WiFi for the internet was slow or not working. And, 7.2% didn't like having to remember to charge their device. One student responded, "[Chromebooks] can sometimes be really slow. And the WiFi is slow sometimes too, which can disturb learning."

Also, 13.4% of students don't like how their peers act during traditional formative assessments (see Table 14). Another student responded, "What I don't like for the think pair shares is that sometimes the person next to you isn't really into it so they don't participate." 7.2% of students don't like when their peers get distracted by their Chromebooks (see Table 15).

Table 15.

| *Student Responses: What don't you like about Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod? (Digital Formative Assessment)* | |
|---|---|
| There is nothing I don't like about Chromebooks and digital formative assessments. | 37.1% |
| I don't like when the WiFi for internet is slow or not working. | 22.7% |
| There are specific digital assessments I don't like. (Students listed Kahoot, Quia, and Nearpod.) | 11.3% |
| I don't like that I have to remember to charge my Chromebook. | 7.2% |
| I don't like when my peers get distracted on their Chromebook. | 7.2% |
| I don't like when I get confused on my Chromebook. | 5.1% |
| I don't like Chromebooks and digital formative assessments because I prefer paper and pencil. | 3.1% |
| I don't like when I get embarrassed because my peers can see my answers on | 2.1% |

| | |
|---|---|
| questions in Google Classroom. | |
| Unreadable | 2.1% |
| I don’t like Chromebooks for other various reasons | 2.0% |

When asked open-ended questions, the most students responded that they didn’t like traditional formative assessments because they like using their Chromebooks better (see Table 14). When asked what they didn’t like about digital formative assessments on their Chromebooks most students responded nothing (see Table 15). The students surveyed bring their own device to class every day and devices have been used on a daily basis. That may play into why they prefer to use Chromebooks over traditional formative assessments.

Also, 13.4%, responded that they don’t like sharing with the whole class during traditional formative assessments (see Table 14). Another students responded, “I don't like the thumbs up thumbs down because if I don't know something I don't need everybody else to see that (especially if everybody knows that thing and I don't).” Only 2.1% reported being embarrassed about sharing answers on their Chromebooks (see Table 15).

Table 16.

| *Student Responses: What do you like about paper/pencil exit slips, think/pair/shares, and thumbs up/down?*<br>*(Traditional Formative Assessment)* | |
|---|---|
| I like sharing my answer with the class and learning from my peers. | 39.2% |
| I like that traditional formative assessments helped me learn. | 16.5% |

| | |
|---|---|
| I like writing on paper better than using a Chromebook. | 10.3% |
| I thought traditional formative assessments were just okay. | 10.3% |
| I like traditional formative assessments because they are quick and easy to do. | 8.2% |
| I like that traditional formative assessments helped me communicate with the teacher. | 6.2% |
| I did not like traditional formative assessments. I would rather do them on a Chromebook. | 6.2% |
| There is nothing that I liked about traditional formative assessments. | 3.1% |

Most students like sharing with the class and learning from others through traditional formative assessments (see Table 16). One student responded, "It helps me see what I learned and what other people learned." Most students used the word "fun" to describe why they like Chromebooks for digital formative assessments (see Table 17). Another student responded, "[Chromebooks] make the games fun, and at the same time we are learning things we need to know."

Table 17.

| *Student Responses: What do you like about Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod? (Digital Formative Assessment)* | |
|---|---|
| I like that the Chromebooks and digital formative assessments make learning fun. | 36.1% |
| I like that it is technology based and I get to use my Chromebook instead of paper and pencil. | 18.6% |
| I like Chromebooks and digital formative assessments because they help me learn. | 16.5% |
| I like Chromebooks and digital formative assessments because they are fast and easy to use. | 11.3% |

| | |
|---|---|
| I like Chromebooks and digital formative assessments because they are interactive. | 5.1% |
| I like that Chromebooks and digital formative assessments make class more interesting, engaging, and motivating. | 4.1% |
| I like Chromebooks and digital formative assessments because they are games. | 3.1% |
| I like everything about Chromebooks and digital formative assessments. | 2.1% |
| I like that everyone in the class is trying to get the right answers and you can see everyone's answers. | 2.1% |
| I like that Chromebooks and digital formative assessments don't show names and who got answers wrong. | 1.0% |

When asked, What do you like about Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod, 16.5% of students in both the traditional and digital survey responded that each formative assessment helped them learn (see Tables 16 and 17). One student's response on traditional formative assessments, "I like how you have to think and pause and remember what you learned and just not forget about it in the first day." A different response about digital formative assessments, "When I challenge myself with games to study I remember them longer."

Also, 10.3% of students responded that they prefer writing on paper versus using a Chromebook (see Table 16). One student responded, "If we do things on paper we don't have to type things and wait for people to finish." Another student gave a different perspective, "I like the paper/pencil exit slips because there are some unique answers that I wouldn't think of." Additionally, 18.6% of students responded that they liked using Chromebooks for digital formative assessments simply because they were on the

computer (see Table 17). Another student responded, “I like how you can play Quizlet Live and you cannot do that with paper and pencil.” This student has recognized that some digital formative assessments cannot be replicated on paper with pencil.

**Connections with the Literature Review**

It was found that student summative assessment scores stayed the same whether they used traditional formative assessments alone or a combination of traditional and digital formative assessments. This is puzzling at first, but showed that formative assessment of either kind is helpful to learning. Students in both groups averaged about an eighty-eight percent on the summative assessment, which is a B+ letter grade. When done well formative assessment is one of the most powerful tools a teacher has in helping student achievement (Stiggins & DuFour, 2009).

Students responded on the surveys that they like both types of formative assessments and that both types help them learn. Students reported through the survey that both types of formative assessments motivate them and made science class more interesting. Ecclestone (2010) as well as Cauley and McMillan (2010) argued that formative assessment or assessment for learning is considered an integral component of good teaching, student motivation, engagement and higher levels of achievement.

In each instance more students selected digital formative assessment choices over traditional formative assessment choices; 94.8% responded that they like Chromebooks to paper/pencil. When asked what they like about Chromebooks for digital formative assessments 36.1% responded that it was because they made learning fun in science class

this year. Students recognize that they learn from both traditional and digital formative assessment, but digital formative assessments are fun in their words. “Since students are already interested and engaged in technology, teachers can harness that attention for educational purposes” (Capella Education Blog, May 23, 2017). There is a strong correlation between interest, engagement, motivation, and the ability to understand science and engineering (Ateh & Charpentier, 2014). Technology can be used to strengthen student engagement through motivation and providing scenarios where students make their unique contributions (Keeler, 2016b), such as through a blog or video (Keeler, 2016b and Niemi & Multisilta, 2015).

Formative assessment is a powerful tool, if used correctly, can help improve student achievement. Students are engaged when they are actively participating in their education. Technology is just one way to engage students.

**Summary**

When executing this research project, my purpose was to determine how digital formative assessment impacted student learning and also to reflect upon the impact technology has on my teaching. In this chapter, I have presented both the quantitative and qualitative results of my research study. In chapter five, I will discuss major findings, connect these findings to the literature review, consider implications of my research for classroom teachers, discuss limitations of this study, and propose possible further research needed on this topic.

# CHAPTER FIVE

## Conclusions

### Overview

The previous chapter presented the results of my research that attempted to find the answer the question, *how integrating digital formative assessment impacts the learning of sixth-grade science students?* I presented the quantitative and qualitative data and drew conclusions regarding the effectiveness of both traditional and digital formative assessment. In this chapter, I will reflect on the capstone process, connect my research to the literature review, discuss the possible implications and limitations of this research, discuss possibilities for future research, and share the plan for communicating these results.

### Reflections

When I started the capstone process, I knew my topic would be on technology. When I told my colleagues I was starting my capstone, they all asked, "You picked a topic with technology right?" Technology is my passion, and it shows. For many of my students technology is their passion as well. They were excited on the days when we used technology in class. They have been immersed in technology since the day they were born.

I then had to determine what I wanted to know and study about technology. My district was pushing teachers to incorporate more formative assessments, so I decided to combine the two topics. I had been trying many new digital formative assessments in

class and wanted to know if it was helping student achievement. Most students seemed engaged in the activities, but how would they respond when asked about digital formative assessments in a survey?

I had my guesses on what the results would be. I thought the students who used digital formative assessments, as well as traditional formative assessments, would score higher on the summative assessment than the students who used only traditional formative assessments. They were getting more formative assessment in general, and they seemed more engaged with the digital formative assessments. However, in this study, both groups of students scored the same on the summative assessment.

The survey results showed that most students are more comfortable using Chromebooks over paper and pencil. Most students like Chromebooks for formative assessment over traditional formative assessments. Most students reported that digital formative assessments help them learn more, were more interesting and motivating.

What was most interesting to me was in the student survey results. Yes, most students preferred Chromebooks over paper and pencil. However, students recognized that they learn and are motivated by both types of formative assessment. They reported that like both types and both make class more interesting. This is encouraging and primary evidence for the use of formative assessment.

As a teacher what I enjoyed about the digital formative assessments was the time-saving element. As I mentioned in the Procedure Section of Chapter Four, the digital formative assessments allowed for immediate feedback. Not only do the students

enjoy this feature, but as a teacher, I could change my lesson on the fly based on what my students needed at that moment. Additionally, many of the digital formative assessments do the grading process for the teacher.

The capstone process and results reinforced for me the concept of teacher-researcher. I was introduced to this concept my first year of teaching by being part of a lesson study. A lesson study is a form of long-term professional development in which teams of teachers collaboratively plan, research, and study their lesson instruction as a way to determine how students learn best. Also, as a science teacher, I instruct on research practically every day. But, I had gotten away from being a true teacher-researcher in most regards. However, I had continued giving student surveys. Approaching teaching thinking like a researcher has given me energy; it gives intention and direction to my teaching. I am more willing to try new things, to collect data and compare it, and to involve my students in the process by soliciting their ideas and feedback. I had given the surveys before but always seemed to run out steam when going through the results. The capstone process has given me the enthusiasm to continue as a teacher-researcher.

**Connections to the Literature Review**

Students currently enrolled in K-12 education are digital natives. They are represented as living lives immersed in technology, surrounded by and using computers, videogames, digital music players, cell phones, and all the other toys and tools of the

digital age (Bennett, Maton, & Kervin, 2008). Teachers cannot ignore this fact when planning instruction.

The discussion on formative assessment and engagement proved to be important to my capstone. I saw its reality unfold in my classroom as the research began. Students need to be actively engaged to achieve (Parsons, Richey Nuland, & Ward Parsons, 2014). On-task does not necessarily mean engaged (Parsons et al., 2014). As I looked out at my class, I wondered how many were actively engaged and how many just looked on-task but were digitally distracted. The survey results showed that overwhelmingly the students thought the formative assessments helped them learn and were motivating and interesting. There is a strong correlation between interest, engagement, motivation, and the ability to understand science and engineering (Ateh & Charpentier, 2014).

In the past, I had been using traditional formative assessments. But with the 2017 student group, I started using digital formative assessments. I had to decide what digital formative assessments were appropriate to add to the curriculum and when to implement them. When using technology, it should make a lesson better (Keeler, 2016b). Keeler (2016b) goes on to say, “Technology does not create engagement, your lesson design does.” So I chose to use the Chromebooks that students were bringing to class daily as part of the school bring your own device initiative. The digital tasks I chose were questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod (see Appendix D). I chose them because there weren’t simply substitutes for paper and pencil. Each one required students to be actively learning, collaborating, and reflecting.

Technology is best used in the classroom when students are using it to collaborate, reflect, or create (Keeler, 2016b).

Being intentional about using formative assessment in my teaching on a daily basis reminded me how powerful it could be. Formative assessment, when used correctly, is transformational, since both teacher and student benefit from the timely feedback and adjustment of the curriculum. The benefit not only shows in student achievement but the joy one gets from going to class each day.

**Possible Implications**

Based upon the conclusions drawn from my data collection, formative assessment should be used in classrooms today because it increases engagement, motivation, and interest. In this study, it was found that with or without technology students can achieve at high levels. However, while students recognize that both traditional and digital formative assessments help them learn, most students prefer digital over traditional. Technology is part of everyday life for students; these digital natives, who have grown up surrounded by technology, are so familiar with technology that educators cannot refuse to take notice of the large role it plays in how they learn. In order to implement technology successfully in the classroom, teachers should seriously consider the benefits and drawbacks of each particular digital program, and how it suits their student population.

The suggestion that technology should be used in the classroom cannot be

separated from thinking about what makes meaningful technological integration; technology is best used in the classroom when students are using it to collaborate, reflect, or create (Keeler, 2016b). Teachers should consider how best to use technology in their classroom to meet student achievement goals. Lastly, simply adding technology to a classroom will not guarantee meaningful learning will take place.

**Possible Limitations**

The research I conducted provided many positive results and useful feedback, but I did find some possible limitations to my data. The research time was limited to one unit of study. For this particular research question, more time would have been beneficial. The results could have been different if the summative assessment results of both the 2016 and 2017 student groups were compared over three units of study or even throughout an entire school year. An extended period of time would also have allowed for further track changes in motivation. The surveys were given in the third school trimester to the 2017 group. The results could have been different if those same surveys were given in trimester one and/or two.

A large limitation was comparing two different groups, since I needed to research the results on the same unit. Student abilities would be different among the two groups and impacted the true difference in summative assessment outcomes. As a result, repeating this difference in formative assessment use over three units, or more, would have been useful to better determine the possible impact.

The surveys were only given to the 2017 student group. It would have been interesting to see how the 2016 student group would have responded to the traditional formative assessment survey in comparison to the 2017 student group. The 2016 student group only occasionally used technology and never for formative assessment, so their responses to the traditional formative assessment may have been stronger toward paper and pencil than the 2017 group that had done a combination of both types of formative assessments.

Lastly, there is a relatively small body of research that only pertains to digital formative assessment and its benefits and drawbacks. The literature review for this research project drew upon what was available but also had to incorporate the separate bodies of research on technology integration, student motivation, and formative assessment to draw its conclusions.

**Future Research**

Future researchers might want to investigate if certain digital tasks increase motivation over others. It would be interesting to know what types of digital tasks students find boring and would actually increase the amount of off task behaviors.

Future researchers might also want to do a longterm study. Does the fun of digital devices wear off? After students have been in a 1:1 environment for seven years, how do they respond to survey questions on engagement and motivation.

**Communicating Results**

Gaining an understanding about the benefits of student motivation and formative assessment enables me to share the results with other colleagues. Learning opportunities delivered to staff at an after school workshop or PLC would provide an opportunity to share my results in a way that could help in my colleagues' classrooms. As a member of the district technology committee, I will utilize the research data, explain the importance of formative assessment in engagement, and describe how I used digital formative assessments. The capstone findings will also be posted on my classroom website for the school board, principals, and parents to view.

**Summary**

Throughout this chapter, I reflected on the capstone process and considered the impacts it had on who I am as a teacher. I revisited the literature review and considered how my research is connected to it, as well as what areas of the literature review proved to be most helpful to me as I conducted my research. I also discussed possible topics of future research and the implications and limitations of my study.

The prevalence of technology in schools today served as the driver for my capstone research question, *How integrating digital formative assessment impacts the learning of sixth-grade science students?* I especially wanted to discover if there was a difference in student achievement when using traditional versus digital formative assessments. Technology has made its way into mainstream society and the classroom, and it is here to stay. I leave this experience with a completely different outlook about

how students perceive formative assessment. Writing this capstone has been a long and often overwhelming experience, but the knowledge I have gained along the way is invaluable. As I end my capstone journey, here is the major conclusion I have reached: Choice is a key component in learning. Students should be offered a wide variety of ways to learn, in my situation, from paper and pencil to an electronic device.

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APPENDIX A
Letter of Consent

March 8, 2017

Dear Parent or Guardian,

I am completing my Master's Degree in Education through Hamline University. As part of my graduate work, I plan to conduct research in late March to early April 2017. **The purpose of my letter is to ask your permission for your child to take part in my research.** For parents who would like to see the results, the final product will be a printed, bound capstone (thesis) that will be shelved in Hamline's Bush Library. It will also be available online via Digital Commons at Hamline.

My research will study the use of digital formative assessments. It will require your child to take a student survey describing their personal preferences regarding the use of an electronic device or paper/pencil formative assessments. My main goal is to see if there is any change in comprehension or motivation from the use of digital formative assessment.

Your child's participation is optional and will take place in my classroom during their daily scheduled class time in a whole group setting. I will also be working one-on-one with the students during this time. Your child will not be asked to do any extra work in the classroom or at home, and there will be no risk to your child for participating.

I may include samples of student work in my final paper. If your child's work is selected, his/her identity will be kept confidential. No real names or identifying characteristics will be used. Student participants will randomly be assigned a letter to represent them throughout the research. Your child is free to withdraw from this project at any time without negative consequences.

I have already received permission to do this research from the superintendent and from Hamline University Graduate School of Education Institutional Review Board. For IRB questions please contact Matthew Olson at mholson@hamline.edu.

**Please return the permission form that is attached by March 21, 2017.** If you have any questions, please feel free to call me at school or email me at any time. Thank you for your cooperation.

Sincerely,
Sara Potter
sara.potter@isd423.org (320) 587-2854 ext. 4402

March 2017

Dear Mrs. Potter,

I have received and read your letter about conducting research in your classroom. I recognize that your goal is to see if there is any change in comprehension or motivation from the use of digital formative assessment.

I give permission for my child, _____, to participate in the research project that is part of your graduate degree program. I understand that all results will be confidential and anonymous and that my child may withdraw from participating at any time without negative consequences.

Signed,

_____
(Parent/Guardian)

Date:_____

# APPENDIX B
## Student Surveys

Survey questions given after traditional formative assessment:

Rating scale used: Strongly agree; agree; disagree; strongly disagree

1. I feel totally comfortable when it comes to using paper and pencil.
2. The paper/pencil exit slips, think/pair/shares, and thumbs up/down help me learn in science class this year.
3. I like using paper/pencil for exit slips, think/pair/shares, and thumbs up/down.
4. The paper/pencil exit slips, think/pair/shares, and thumbs up/down made science class this year more interesting.
5. I like using paper/pencil exit slips, think/pair/shares, and thumbs up/down better than using the Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod.
6. Paper/pencil exit slips, think/pair/shares, and thumbs up/down motivate me to do my best in science class this year.

Short Answer Section:

7. What do you like about paper/pencil exit slips, think/pair/shares, and thumbs up/down?
8. What don't you like about paper/pencil exit slips, think/pair/shares, and thumbs up/down?

Survey questions given after digital formative assessment:

Rating scale used: Strongly agree; agree; disagree; strongly disagree

1. I feel totally comfortable when it comes to using my Chromebook.
2. Questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod helped me learn in science class this year.
3. I like using Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod.
4. Questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod. on the Chromebook made science class this year more interesting.
5. I like using the Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod better than using paper/pencil exit slips, think/pair/shares, and thumbs up/down.
6. Using the Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod motivate me to do my best in science class this year.

Short Answer Section:

7. What do you like about using Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod?
8. What don't you like about using Chromebooks for questions in Google Classroom, Kahoot!, games in Quia, Quizlet, and Nearpod?

APPENDIX C

2016 and 2017 Energy and Waves Summative Assessment for Comprehension

## Multiple Choice Section

1. A hair dryer changes electrical energy into which of the following types of energy?
   - ○ light energy
   - ○ chemical energy
   - ○ thermal energy
   - ○ nuclear energy

2. Which of the following types of energy makes a light bulb feel warm?
   - ○ electrical energy
   - ○ nuclear energy
   - ○ thermal cnergy
   - ○ light energy

3. When you eat fruits and vegetables, which of the following types of energy are you taking in?
   - ○ sound energy
   - ○ electrical energy
   - ○ thermal energy
   - ○ chemical cnergy

4. Which of the following laws states that energy cannot be created or destroyed?
   - ○ law of conservation of energy
   - ○ law of conservation of power
   - ○ law of energy changes
   - ○ law of changing energy

5. What is the kinetic energy (KE) of a 60 kg 6th grade student that is moving at 2 m/s? SHOW your WORK on paper.

6. The amplitude measures what in a wave?
   - ◯ Length
   - ◯ Area
   - ◯ Perimeter
   - ◯ Height

7. The particles in a transverse wave move...
   - ◯ side to side
   - ◯ parallel to the motion of the wave
   - ◯ diagonal
   - ◯ perpendicular to the motion of the wave.

8. What type of wave is a sound wave?
   - ◯ Longitudinal
   - ◯ Qualadonal
   - ◯ Transverse
   - ◯ Surface

9. A wave is _____.
   - ◯ The speed a wave travels through a medium.
   - ◯ A disturbance that transmits energy through a medium.
   - ◯ One complete back and forth motion.
   - ◯ A combination of longitudinal and transverse waves,

10. As you move from left to right along the Electromagnetic Spectrum, wavelength becomes...
    - ◯ curlier
    - ◯ longer
    - ◯ shorter
    - ◯ taller

11. What is frequency's unit of measure?
    - ◯ Ounces
    - ◯ Hertz
    - ◯ millimeters
    - ◯ centimeters

12. What color will reflect all light back to its source?
    - ◯ Black
    - ◯ Purple
    - ◯ White
    - ◯ Blue

13. When light hits a smooth surface such as a mirror the light will scatter everywhere.
    - ◯ True
    - ◯ False

14. Light travels as a wave through space
    - ◯ True
    - ◯ False

15. Radio waves have a shorter wavelength than Visible Light.
    - ◯ True
    - ◯ False

16. Frequency is measured in centimeters (cm).
    - ◯ True
    - ◯ False

17. A mirror is a source of light.

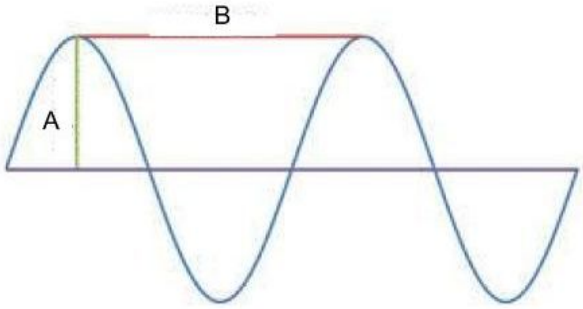
- ○ True
- ○ False

18. Match the answers to correctly fill in the blanks.

- _____ light is the electromagnetic wave that humans can see.
- _____ waves need a medium.
- The top of a transverse wave is called the _____.
- All waves transmit _____.
- The _____ the wavelength, the more energy is carried.
- The _____ Spectrum includes all types of waves that do not need a medium to travel.
- A _____ is one complete back and forth motion of a particle.

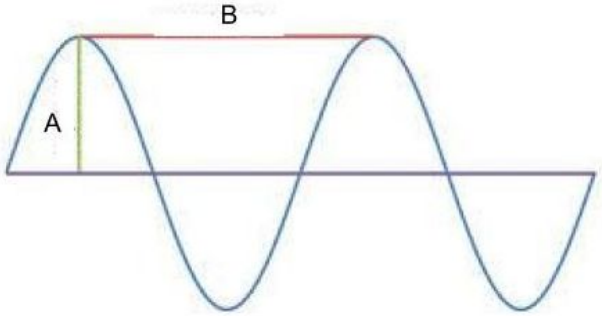
a. vibration
b. energy
c. shorter
d. mechanical
e. electromagnetic
f. visible
g. crest

19. In the picture below, which letter is Wavelength?




- ○ A
- ○ B

20. In the picture below, which letter is Amplitude?




- ○ A
- ○ B

**Short Answer Section**

Choose ONLY TWO out of the NEXT FIVE essay questions to answer. If the answers are not in complete sentences it will be an automatic one point off.

2. Explain how the energy from a wood fire actually comes from the sun.

3. How is water turned into electrical energy?

4. Name two ways your body uses food for energy.

5. How does energy get destroyed?

6. How is energy transferred when a boy eats lunch and then rides his bike to a friend's house?

Choose ONLY TWO out of the NEXT FOUR essay questions to answer. If the answers are not in complete sentences it will be an automatic one point off.

7. How come a green shirt is green? Explain.

8. If the shirt does not produce light then how can we see it?

9. What does ROY G BIV stand for? You can list them.

10. Will a black shirt or a white shirt absorb the most light? Why?

APPENDIX D
Description of Digital Formative Assessment Tools Used

| Digital App | Description |
|---|---|
| Google Classroom (https://classroom.google.com/) | Classroom is a free web-based platform that integrates Google Docs, Gmail, and Google Calendar. Classroom saves time and paper, and makes it easy to create classes, distribute assignments, communicate, and stay organized.<br><br>Create class discussions—In the class stream, post announcements, engage students in question-driven discussions, or move important topics to the top.<br><br>Manage class discussions—Control who can post to the class stream and mute individual students from posting or commenting.<br><br>Share content—Share links, videos, and images from websites to Classroom with one click in the Share to Classroom extension.<br><br>Teachers can quickly see who has or hasn't completed the work, and provide direct, real-time feedback and grades right in Classroom. |
| Kahoot! (https://getkahoot.com/) | A Kahoot! is a collection of questions on specific topics. Created by teachers, students, business-people and social users, they are asked in real-time, to an unlimited number of "players", creating a social, fun and game-like learning environment.<br><br>Currently, there are 3 types of Kahoot!: Quiz, Discussion, and Survey.<br><br>Results, including who answered what for each question, can be downloaded afterwards. |
| Nearpod (https://nearpod.com/) | Interactive mobile presentations that teachers create and customize themselves. |

| | |
|---|---|
| | Create interactive classes- Upload a pdf or start a new presentation and add interactive features.<br><br>Share content and assessments in real time- Include quizzes, polls, slideshows, videos and other activities in your lessons.<br><br>Engage- Multimedia content captures students' attention, keeping them focused and minimizing off-task behavior.<br><br>Monitor your students- Observe classroom activity and easily control students' devices. |
| Quia (https://www.quia.com/web) | Create your own educational games, quizzes, class Web pages, surveys, and much more! Explore millions of activities and quizzes created by educators from around the world.<br><br>-Templates for creating 16 types of online activities using your own content.<br><br>-A complete online testing system with automatic grading, immediate feedback, and detailed reporting.<br><br>-Online surveys for gathering student and teacher feedback.<br><br>-A class Web page creator to share Quia activities and class announcements with students and parents.<br><br>-Access to millions of shared activities and quizzes in over 300 categories. |